

What is claimed is:

1. A method of hydroforming a tube section comprised of a male tube section having an end portion received within and overlapping an end portion of a female tube section, comprising:

curing an adhesive disposed within an annular space defined between said male and female tube sections; and

hydroforming the resulting tube section into a desired shape.

2. The method according to claim 1, further comprising providing an inlet hole in said female tube section to introduce adhesive to said annular space.

3. The method according to claim 2, further comprising providing an exit hole in said female tube section.

4. The method according to claim 1, wherein said adhesive comprises a two-part epoxy adhesive.

5. The method according to claim 1, wherein each of said male and female tube sections comprises one of galvanized steel and aluminum.

6. The method according to claim 2, further comprising injecting adhesive into the annular region prior to the step of curing the adhesive.

7. The method according to claim 3, wherein said exit hole is aligned about 180 degrees from said inlet hole.

8. The method according to claim 1, further comprising cleaning the overlapping area of the male and female tube sections prior to assembling the tube sections.

9. The method according to claim 1, wherein there are a plurality of annular spaces between said male and female tube sections, each annular space comprising an inlet hole.

5 10. The method according to claim 9, wherein each annular space comprises an exit hole.

11. The method according to claim 9, comprising injecting adhesive through each inlet hole into its corresponding annular space.

10 12. A method of hydroforming a tube section comprised of a male tube section having an end portion received within and overlapping an end portion of a female tube section, at least one of said end portions comprised of an annular groove forming an annular space between said male and female tube sections, and an inlet formed in one of
15 said end portions in communication with said annular space for injection of an adhesive into said space, said method comprising:

injecting an adhesive through said inlet into said annular space;
curing the adhesive to bond said male and female tube sections together; and
hydroforming the tube section into a desired shape.

20 13. The method according to claim 12, further comprising providing an exit hole in the same tube section as said inlet hole, about 180 degrees from said inlet hole.

25 14. The method according to claim 13, wherein injecting an adhesive comprises injecting adhesive into said inlet hole until the adhesive begins to exit said annular space through said exit hole.

30 15. A method of forming a composite frame structure, comprising:
arranging a plurality of metal frame components into a birdcage structure so as to define a plurality of joints defined by overlapping portions of adjacent components, each

of said joints comprising a circumferential space formed between the overlapping portions of the adjacent components;

injecting an adhesive into each of the annular spaces;

curing the adhesive; and

5 hydroforming the resulting birdcage structure into a desired shape.

16. The method according to claim 15, wherein each annular space comprises an adhesive inlet hole and an adhesive exit hole, said step of injecting an adhesive into each of the annular spaces comprises injecting adhesive through each said inlet hole into
10 its corresponding annular space.

17. A hydroformable article comprising:

a female metal tube portion and a male metal tube portion, a portion of said female tube portion being disposed about a portion of said male tube portion;

15 a groove disposed in one of said male tube portion and said female tube portion to form an annular region between said male tube portion and said female tube portion; and

a cured adhesive disposed in said annular region between said male tube portion and said female tube portion,

20 wherein said metal of said female metal tube portion, said metal of said male metal tube portion and said adhesive are chosen so as to endure a hydroforming process.

18. The hydroformable article according to claim 17, wherein the article forms part of a body frame element.

25 19. The hydroformable article according to claim 18, wherein the body frame element comprises a portion of a vehicle frame.

20. The hydroformable article according to claim 18, wherein the body frame element comprises a portion of an automobile frame.

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21. The hydroformable article according to claim 17, wherein the article is capable of withstanding hydroforming pressure greater than about 5000 psi.

22. The hydroformable article according to claim 17, wherein said adhesive has a minimum shear yield strength of at least about 5000 psi.

23. The hydroformable article according to claim 17, wherein said metal of said male tube portion and said metal of said female tube portion has a minimum yield strength of at least about 30,000 psi.

24. The hydroformable article according to claim 17, wherein said metal of said male tube portion and said metal of said female tube portion are the same metal.

25. A hydroformed article comprising:
a female metal tube portion and a male metal tube portion, a portion of said female tube portion being disposed about a portion of said male tube portion so as to form a joint;
a groove disposed in one of said male tube portion and said female tube portion to form an annular region between said male tube portion and said female tube portion; and
a cured adhesive disposed in said annular region between said male tube portion and said female tube portion,
wherein said female tube portion and said male tube portion having been permanently deformed by hydroforming.

26. The hydroformed article according to claim 25, wherein said female tube portion includes a remainder portion outside of said joint, said male tube portion includes a remainder portion outside of said joint, and the remainder portion of said male tube portion being disposed at an angle of greater than or less than 180 degrees to the remainder portion of said female tube portion.

27. The hydroformable article according to claim 25, wherein the remainder of said female tube portion and the remainder of said male tube portion form one of an L-shape, T-shape, S-shape and a cross-shape.

5 28. The hydroformable joint according to claim 25, wherein said groove is formed in said male tube portion, and said female tube portion does not contain a groove.